USING PHYSIOLOGICAL MEASUREMENT TO BETTER UNDERSTAND LEARNER SELF-MONITORING AND USAGE PATTERNS OF VARIABLE SPEED PLAYBACK TECHNOLOGY IN DIGITAL VIDEO-BASED INSTRUCTION

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Problem Introduction

It has long been held that cognitive performance and learning is best facilitated by some optimal level of stress or arousal state, above or below which learning potential falls away (Hebb, 1955; Tiegen, 1994; Mendl, 1999). This concept has been simplistically represented by an inverted U curve, known as the Yerkes-Dodson law. Most technologies undergo some form of user testing, but few technologies used to support teaching and learning are tested as to their impact on learner stress and how that relates to cognition and learning. That is, insufficient knowledge exists on how individual's stress reactivity and usage patterns of various technologies impact their learning. Any understanding that is gained, relies commonly on self-reported data (think aloud, survey, interview and focus groups). Such data, however, is unlikely to adequately or accurately describe a learner's stress and arousal states while using a given technology. In an effort to more judiciously apply technology, this study aims to look at how levels of stress (both self-reported, and physiologically measured) correlate with learner's usage patterns of Variable Speed Playback (VSP) technology.

Literature Review

Self reported data can provide many useful measures, but much research suggests that subjective reports of arousal, stress or anxiety seldom correspond with physiological measures (Glynn, Christenfeld & Gerin, 1999). The ability to self-monitor one's attentiveness and level of stress is, however, a critical characteristic of any self-regulating learner (Zimmerman & Schunk, 2001).

Arousal levels are not uniformly observed or measured. It is more complex than a uni-dimensional continuum from deep sleep to high agitation or anxiety (Lacy, 1967; Ursin & Eriksen, 2003). Lacy discusses at least three kinds of arousal: cortical, autonomic and behavioral that often act situationally independent of one another. This non-uniform response is known as directional fractionation (Stern, Ray & Quigley, 2001). A number of physiological measures have proved reliable in measuring arousal and stress in individuals. These include electrodermal activity (EDA), respiration, heart rate (HR) and blood pressure (BP). (Stern et al, 2001; Clariana, 1992)

- EDA and EDR have a relatively long, stable history. (Stern et al, p.206) Skin conductance reflects emotional responding and cognitive activity. It is less sensitive to breathing artifacts than HR. In 1907, Carl Jung claimed that verbal responses do not tell all and that EDA revealed the secrets of mental life.
- BP and HR, are associated with arousal, although not always in an expected way. It is hypothesized that heart rate might decelerate in order to permit information to be processed more effectively (Lacy, 1967 as cited in Stern et al, p.183) this may be the case in cognitively stressful situations perhaps where motor activity or response (i.e. fight or flight) is not anticipated.

Study Background

Variable Speed Playback (VSP) has recently experienced a resurgence in availability and popularity. A previous study (Galbraith & Spencer, 2002) showed that given the technology to accelerate prerecorded online lectures, students report regularly accelerating through instructional presentations up to 2.1 times the normal playback speed over the course of a semester. Many students even requested the ability to accelerate beyond the tool limit of 2.5 times normal speed. Many years ago, Berlyne (1960) hypothesized that arousal increased with task complexity and difficulty. Listening to accelerated audio/video instructional materials for comprehension, causes

quite perceptibly high levels of arousal and stress, which also appear to habituate over time. This elevated state of stress is likely caused by a concerted effort to attend to and encode the high volume of material being presented at rapid rates.

Most students accelerated presentations with VSP, but a few students choose to use no acceleration, or very little acceleration. Was it stress levels that motivated students to adjust (or not) the speed of presentations? Self-reported reasons varied widely, from needing to catch a bus, to adjusting speed based on the individual's ability to process the instructional materials and their levels of prior knowledge of the materials being presented.

Significance of the Study

Whereas at the time of this original study (2001), VSP functionality was only available through specialized hardware or software, today, the ability to control the playback speed of digitized audio and video is available to learners on the two largest media players on the market—in one case (Microsoft Windows Media Player 9), at no cost to the user or course developer. Learners can now listen to audio/video-based instruction at their desired speed, regardless or independent of whether the instructor or course developers ever intended the materials to be accelerated.

The results of this study will be an increased understanding of learner VSP usage patterns, and their relationship to self-regulation of stress and perceived learning. This understanding should help guide courseware developers design VSP integration as well as provide self-monitoring and self-regulation strategies to help students effectively use the technology to promote optimal attentiveness and learning.

Research Questions

In light of this information, and the somewhat alarmingly high average speed reportedly used by students (2.1x normal speed) this study will seek to gain insight into how students self-monitor their stress level and what relationship exists between speed adjustments self-regulation of stress levels.

1. What are the nature and patterns of student VSP usage for a given presentation? (researcher observation)
2. How do students explain their acceleration/deceleration patterns in relation to stress levels or perceived learning? (participant self-report)
3. How does their self-reporting correlate with arousal/stress reactivity measurements? (semi-structured interviews, grounded reflection)
4. To what degree are sustained levels of high stress tolerated, and what motivates such behavior? (semi-structured interviews, grounded reflection)

Overview of Study

It is determined that such research questions are best answered using largely qualitative methodology and techniques. A Grounded Theory (GT) approach that draws heavily on phenomenological methods, seems most appropriate to describe the essence of learner's VSP usage patterns and their relationship to stress regulation and perceived learning.

Participants will made aware of IRB procedures and right to opt out of study. They will be given a brief review of study and told that they will be viewing some video-based instructional materials on the computer. They will be provided with a tool to accelerate the video materials and will be asked to listen intently to the material as

a test (no test will be administered) will be issued following the viewing. In order to encourage use of the acceleration tool, participants will be told that they can leave as soon as they're done viewing the materials and taking their test. Participants may also stop and replay materials as perceived necessary for comprehension.

A key aspect of gathering data in this type of study will be individual student reflection interviews following the treatments. After briefly analyzing and marking salient points in the physiological and self-report data, the interviewer will direct the student to discuss all areas of significant change in student arousal measures looking for correlations between where speed might have been adjusted, and/or clips were re-viewed. Instructional materials may be reviewed during the interview to help participants more accurately recall and describe their stress levels or behavior during specific portions of the instruction.

Methodology

Study Population.

20 undergraduate and graduate students from the school of education. Participants should represent a good mix of gender, age, ethnicity, year in school. (Randomization and generalizability is not a goal of qualitative research)

Location of Study

Although ecologically validity is valued in such studies, it is unfeasible due to the lack of ambulatory measurement devices available to the researcher. Study Participants will instead be brought into a lab setting (PSU media lab) in groups of 4, be observed, but be interviewed individually. A Two-way mirrored room will be used for unobtrusive observation/recording of participant behavior during treatments.

Duration

The study should last no more than 125 minutes. (see detail below)

- 10 minutes for informed consent review/introduction and to get “connected” to GSR and Cardiac devices.
- Take baseline measurements
- 5 minutes to acclimate to VSP tool and accelerated speeds (warm up)
- Begin treatment (Up to 50 minutes to view primary instructional materials)
    - Participants fill out “stress” and “speed” self-report
    - Content is challenging?: Strongly agree, somewhat agree, neither, somewhat disagree, strongly disagree.
    - Comfortable with speed?: Strongly agree, somewhat agree, neither, somewhat disagree, strongly disagree.
- Disconnect, and await interview in lobby (5-15 minutes)
    - Concurrently, Researcher reviews and marks notes for talking points.
- Conduct interview, and debriefing (20-40 minutes)

Equipment and Personnel

- Equipment: EDA Biopac (EDR), Heart Rate/Blood Pressure monitor, Data analysis computer, Treatment computers (x3) (All electrodes and measurement equip supplied by PSU Media lab)
- Three observers/interviewers will be needed at all times.
- Interviewers will observe and take notes on participants (flag areas of interest)
- Interviewers analyze and mark relevant physiological data
- Interviewers conduct interview (interviews recorded)

It is believed that this methodology will provide valuable insight into what motivates different VSP usage patterns in learners, and shed light on the added value of different physiological measures in understanding how learners interact with learning-support technologies such as VSP.

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